REMARKS

Claims 1-19 are now pending in the application. Claim 1 is currently amended. No claims are cancelled or newly added by this amendment. The Examiner is respectfully requested to reconsider and withdraw the rejections in view of the amendments and remarks contained herein.
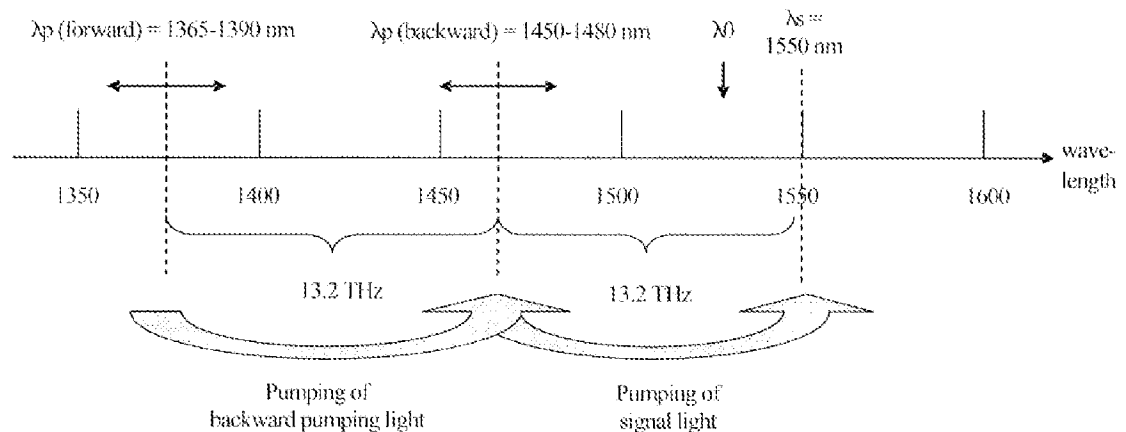

REJECTION UNDER 35 U.S.C. § 103

Claims 1-9 and 14-17 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Islam (U.S. Pub. No. 2003/0133179; "Islam"). This rejection is respectfully traversed.

Islam is directed generally to a Raman amplifier assembly. In Islam, forward pumping light does not pump signal light. Rather, in Islam, the forward pumping light pumps backward pumping light, as shown, for example, in FIG. 3A of Islam (see the phrase "Pump of the pump"). Moreover, Islam does not assume a case in which backward pumping light is not used because the backward pumping light is indispensable to pump signal light.

In contrast, the forward pumping light in applicant's invention pumps the signal light. Moreover, backward pumping light for Raman amplification may be dispensed in applicant's invention because the signal light can be pumped by the forward pumping light. In this way, the pumping scheme as well as the function of the signal light in applicant's claimed invention are different from those taught by Islam. Pending claims have been amended to clarify this distinction with Islam. For at least this reason, it is submitted that the pending claims define patentable subject matter over Islam.

Applicant further notes the difference between the claimed frequency range and the teachings of Islam. Paragraph 183 of Islam, which is pointed out by the Examiner with respect to the claimed frequency difference range, states that "The counter-propagating pump frequency can be 1 Raman order (~ 13.2 THz) higher than the signal frequency... The co-propagating pump frequency can be 2 Raman orders (~ 26.4 THz) higher than the signal frequency ...." In other words, in Islam, the wavelength of pumping light (i.e., backward pumping light when signal light is to be pumped, or forward pumping light when backward pumping light is to be pumped) is set so as to be shorter than the wavelength of light to be pumped (i.e., the signal light, or the backward pumping light; hereinafter referred to as "pumped light") by the wavelength difference corresponding to the frequency difference of 13.2 THz (see the reference diagram provided below and the phrase "13.2 THz separation" shown in FIG. 6 of Islam).

backward pumping (nth order): 1450-1480 nm
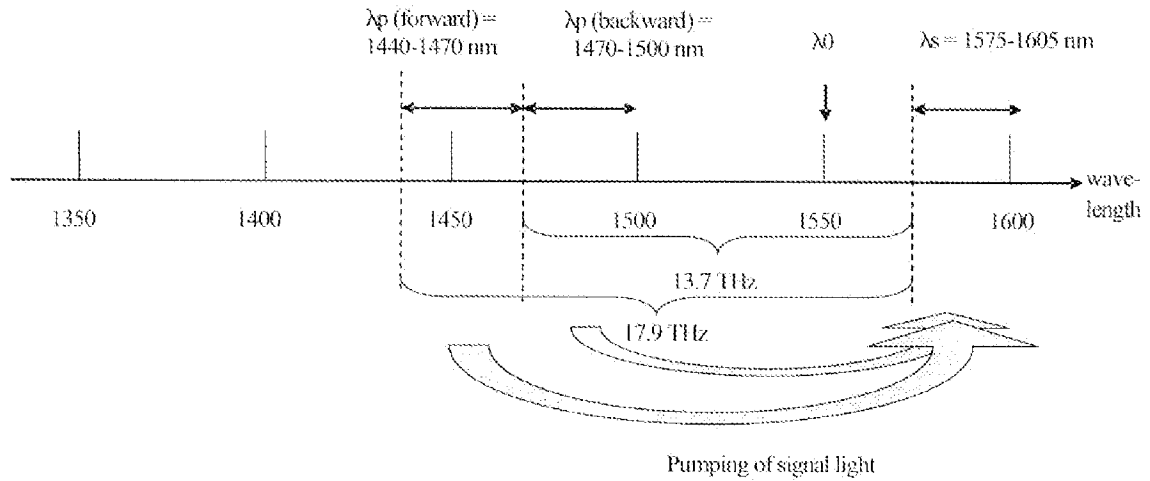forward pumping (n-1th order): 1365-1390 nm

λp (forward) = 1365-1390 nm   λp (backward) = 1450-1480 nm   λ0   λs = 1550 nm

1350   1400   1450   1500   1550   1600   wave-length

13.2 THz   13.2 THz

Pumping of backward pumping light   Pumping of signal light

λp: wavelength of pumping light
λ0: zero-dispersion wavelength
λs: wavelength of signal light

This is because the peak (maximum value) of the Raman gain can be obtained when the frequency difference between the frequency of pumping light and the frequency of pumped light is 13.2 THz (see, for example, paragraph 5, lines 10-12, and FIG. 1 of Islam).

In contrast, in applicant's invention, the wavelength of forward pumping light is not equal to the wavelength that is shorter than the wavelength of signal light (i.e., pumped light) by the wavelength difference corresponding to the frequency difference of 13.2 THz. Rather, in the present invention, the wavelength of forward pumping light is intentionally shifted to a shorter wavelength side than this wavelength, which is shorter than the wavelength of signal light by the wavelength difference corresponding to the frequency difference of 13.2 THz. Specifically, the frequency difference corresponding to the wavelength difference between the longest wavelength of the pumping light and the shortest wavelength of signal light falls within the range of 13.7 to 17.9 THz (see the reference diagram provided below).

backward pumping: 1470-1500 nm
forward pumping: 1440-1470 nm

λp (forward) = 1440-1470 nm   λp (backward) = 1470-1500 nm   λ0   λs = 1575-1605 nm

wave-length

1350   1400   1450   1500   1550   1600

13.7 THz

17.9 THz

Pumping of signal light

λp: wavelength of pumping light
λ0: zero-dispersion wavelength
λs: wavelength of signal light

As a result, although the gain decreases as shown in FIG. 2 of the present application (see the curves of the wavelengths of 1440 nm, 1460 nm, and 1470 nm), the favorable SNR (signal-to-noise ratio) can be obtained in the signal light wavelength region as shown in FIG. 3 of the present application (see the curves of the wavelengths of 1440 nm, 1460 nm, and 1470 nm as well as the first sentence of paragraph 49 of the specification).

If the frequency difference is set to 13.2 THz so as to obtain the peak of the Raman gain as employed in Islam, the SNR is deteriorated. For example, as explained in paragraphs 46 and 48 of the present application, the peak of the gain spectrum within the signal light wavelength region occurs when the wavelength of pumping light is approximately 1470 nm to 1500 nm (see the curves of the wavelengths of 1480 nm, 1490 nm, and 1500 nm shown in FIG. 2 of the present application). However, when the

wavelength of the pumping light is set to 1480 nm, 1490 nm, or 1500 nm, the SNR is deteriorated within the signal light wavelength region as shown in FIG. 3 of the present application.

Claim 1 has been amended to further distinguish the invention from Islam. In particular, Claim 1 has been amended so as to change the range of the frequency difference from previously indicating "13.7 to 30 THz" to now indicating "13.7 to 17.9 THz". Support for this amendment can be found, for example, in FIG. 4 and paragraph 51 of the specification. Specifically, as shown in FIG. 4, the wavelength of pumping light (λp) is 1440 nm, and the shortest wavelength of signal light (λs) is 1575 nm. In addition, as explained in paragraph 51 of the specification, the relationship between a wavelength, a frequency, and the speed of light is given by the following Equation A:

wavelength = speed of light / frequency (A)

Accordingly, the following relationship can be obtained:

frequency = speed of light / wavelength (B)

Since the speed of light is approximately 3×10^8 m/s, the frequency difference between the frequency of the pumping light (1440 nm) and the frequency of the signal light (1575 nm) is calculated as follows:

3×10^8 [m/s] / 1440 [nm] - 3×10^8 [m/s] / 1575 [nm]

= 3×10^8 [m/s] / (1440×10^{-9} [m]) - 3×10^8 [m/s] / (1575×10^{-9} [m])

= 3×10^8 [m/s] × { $1/(1440 \times 10^{-9}$ [m]) - $1/(1575 \times 10^{-9}$ [m]) }

= 3×10^{17} [m/s] × { 1/(1440 [m]) - 1/(1575 [m]) }

≈ 17.9×10^{12} [/s]

= 17.9 THz

Claim 1 has also been amended so as to correct a clerical error. Specifically, the last paragraph of original Claim 1 recites the phrase "on a low-frequency side", but this phrase should read "on a high-frequency side". This is because the longest wavelength of the pumping light is "shorter" than the shortest wavelength of the signal light as recited in Claim 1, and a wavelength is inversely proportional to a frequency as shown by aforementioned Equation A or B. Accordingly, in order to more clearly define the claimed recitation, Claim 1 has been amended based on the language recited in paragraph 51 of the specification ("... the longest pumping light wavelength may be set to the short wavelength side of the shortest wavelength of the signal light so as to have a frequency difference of up to 30 THz...").

For these additional reasons, it is submitted that the pending claims define patentable subject matter over Islam. Accordingly, applicant requests reconsideration and withdraw of the current rejections.

CONCLUSION

It is believed that all of the stated grounds of rejection have been properly traversed, accommodated, or rendered moot. Applicant therefore respectfully requests that the Examiner reconsider and withdraw all presently outstanding rejections. It is believed that a full and complete response has been made to the outstanding Office Action and the present application is in condition for allowance. Thus, prompt and favorable consideration of this amendment is respectfully requested.

If the Examiner believes that personal communication will expedite prosecution of this application, the Examiner is invited to telephone the undersigned at (248) 641-1600.

Respectfully submitted,

Dated: <u>Oct. 29, 2009</u>   By: <u>/Timothy D. MacIntyre/</u>
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